Aneurysms of the Abdominal Aorta and Its Branches

A Study of Untreated Patients *

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WHILE there have been remarkable strides in the surgical approach to intra-abdominal aneurysms, the question of individual selection still remains unanswered. Should all patients with intra-abdominal aneurysms be operated upon? We felt that the natural course of these patients would help decide the range of operability.

The most often quoted figures on survival following the diagnosis of abdominal aortic aneurysm are those of Estes.[5] Our experience appeared to contradict these figures. We have also had the problem of evaluating patients for resection of aneurysms in the presence of advanced age, cardiac, and renal disease. Sufficient data for intelligent patient selection were not available.

Because of a comparatively small series of patients operated upon and a still smaller control group of patients not operated upon, it was decided to study our necropsy records. We desired the natural history of patients with intra-abdominal aneurysms: a characterization of the patients with this disease, clinico-pathologic correlations based on a study of the aneurysm proper, and some prognostic clues as to the ultimate outcome of the disease. This paper summarizes these studies. This survey also serves as a yardstick to compare with the long term survival of patients treated by grafting procedures. To broaden the scope of the work other published untreated studies are included for comparison.

MATERIAL AND RESULTS

The autopsy protocols and clinical data of all patients with abdominal aneurysms from 1940 through 1955 at Kings County Hospital were reviewed. There were 68 such patients. These 68 patients had 96 abdominal aneurysms. Etiologically the patients fell into three main groups: arteriosclerotic, luetic, and mycotic. Surprisingly, two patients had abdominal coarctations below the renal arteries with severe arteriosclerosis and aneurysms below the constriction.* Forty-nine cases were arteriosclerotic, 14 luetic, three mycotic, and two related to the aforementioned congenital lesion and arteriosclerosis. Of the 96 intra-abdominal aneurysms, 72 were aortic, 18

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* One patient was a 43-year-old achondroplastic dwarf with several other mild congenital anomalies. The other was a 40-year-old hypertensive man with no other noted congenital abnormalities. These patients were autopsied some ten years apart and, from the necropsy reports, appear to have had true sub-renal aortic coarctations with post-stenotic dilatation and aneurysm formation. Arteriosclerosis was increased distal to the stenosis.

TABLE 1. *The Age, Sex and Race Distribution of 68 Patients with Intra-abdominal Aneurysms* *

Age	Arterio-sclerotic		Luetic		Mycotic		Other	
	Rupt.	Unrupt.	Rupt.	Unrupt.	Rupt.	Unrupt.	Rupt.	Unrupt.
20–30					1 MC			
30–40			1 MN					
40–50			1 MN 1 FN		1 MC		2 MC	
50–60	2 MC	6 MC	1 FN	1 MC 1 MN		1 MC		
60–70	4 MC 2 FC	6 MC	3 MC	3 MC 1 MN				
70–80	4 MC 4 FC 1 FN	5 MC 5 FC 1 FN						
80–90	3 MC	4 MC 1 FC		1 MC				
90–100	1 MC							
Total 68	21	28	7	7	2	1	2	

* MC—Male Caucasian; FC—Female Caucasian; MN—Male Negro; FN—Female Negro.

were iliac, three were splenic, two hypogastric, and one superior mesenteric.

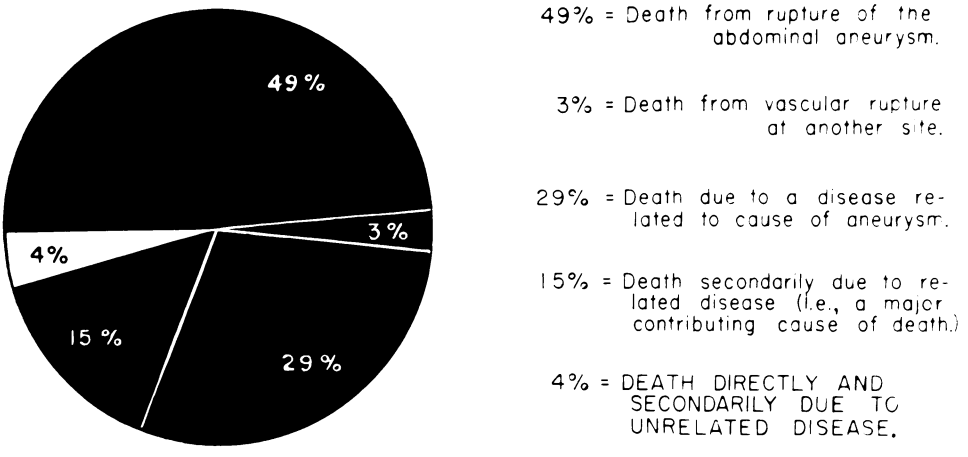
There were 16 patients with multiple aneurysms; nine of these patients had luetic aneurysms, seven had arteriosclerotic aneurysms. Thus, of 14 patients with a luetic abdominal aneurysm, nine had another arterial aneurysm with all but one having an associated thoracic aneurysm. Six of the nine patients with a luetic abdominal aneurysm had another intra-abdominal aneurysm. Of the seven patients with multiple arteriosclerotic aneurysms, four had associated iliac aneurysms.

The age, sex, and race distribution data are detailed in Table 1. There were 52 men and 16 women (a ratio of 3.4 to 1). The age range was 29 to 93. The overall mean age was 70.0, with 72.4 for those ruptured and 69.8 for the unruptured.

The symptoms were varied. Thirteen patients (19%), in fact, were asymptomatic. The remainder of our patients had symptoms ranging from vague abdominal complaints to excruciating back pain. The patient with a rupturing aneurysm commonly had abdominal pain, usually left-sided or left flank, with radiation from the flank to the abdomen, groin, or testicle. There were radiations from the anterior abdomen to the flank as well. A diagnosis of primary renal disease in some cases caused the patient to be admitted to the urology service. This similarity to primary genito-urinary disease has been previously reported.[8]

Six patients showed vertebral erosion. All of these patients had severe back or flank pain. One of these patients twice attempted suicide because of pain. Estes [5] reports a patient who did commit suicide because of unbearable pain. Thirteen patients presented with a disturbing or pulsating abdominal mass. One patient had noted the pulsation and growth in size of a mass for eight years.

The causes of death of the 68 patients are compartmentalized in the pie graph of Figure 1. Of the 68 patients in the study, 33 patients, or 49 per cent died from rupture of the abdominal aneurysm. There were four patients in this group who had a second aortic aneurysm; all of these patients



CAUSE OF DEATH IN 68 PATIENTS WITH AN ABDOMINAL ANEURYSM

FIG. 1.

ruptured the larger aortic aneurysm. Two cases, or 3 per cent, died from vascular rupture at a site other than an abdominal aneurysm: in one case from a middle colic artery severely involved in luetic vasculitis, the second from a ruptured arteriosclerotic thoracic aneurysm.

Of the 33 patients who died not from vascular ruptures, there were 20 patients, or 29 per cent of the total deaths, who died from a disease considered directly related to the cause of the aneurysm. This was either severe coronary, cerebral, or renal arteriosclerosis, or in the case of the luetics, heart failure due to luetic disease. In patients included in this group the related disease was deemed to be the immediate cause of death.

Thirteen patients, or 19 per cent, died from an immediate cause of death not related to the cause of the aneurysm. Of this last group, however, 10 cases, or 15 per cent, had a disease related to the aneurysm listed as a primary or major cause of death, though not the immediate cause.

It therefore turns out that 96 per cent died from either rupture or a related disease either directly or as a major cause of death. These figures to a great degree represent the causes of death ordinarily found in an older age group, excluding neoplasms; nevertheless, it was felt instructive to emphasize the very general character of the disease.

Of the 68 cases, 24, or 35 per cent, showed definite evidence of an old or recent myocardial infarction. There were ten cases in the ruptured aneurysm group and 14 in the unruptured group.

Hypertension was clearly present in 24 of the 51 arteriosclerotic anuerysm patients, or 47 per cent. A systolic value of 160 or diastolic over 100 or a history as a known hypertensive, along with compatible autopsy findings, were the criteria for inclusion in this group. With the high rate of myocardial infarction and the advanced age of the patients it is quite probable that the hypertensive rate is still higher, the blood pressure being in a lower range because of

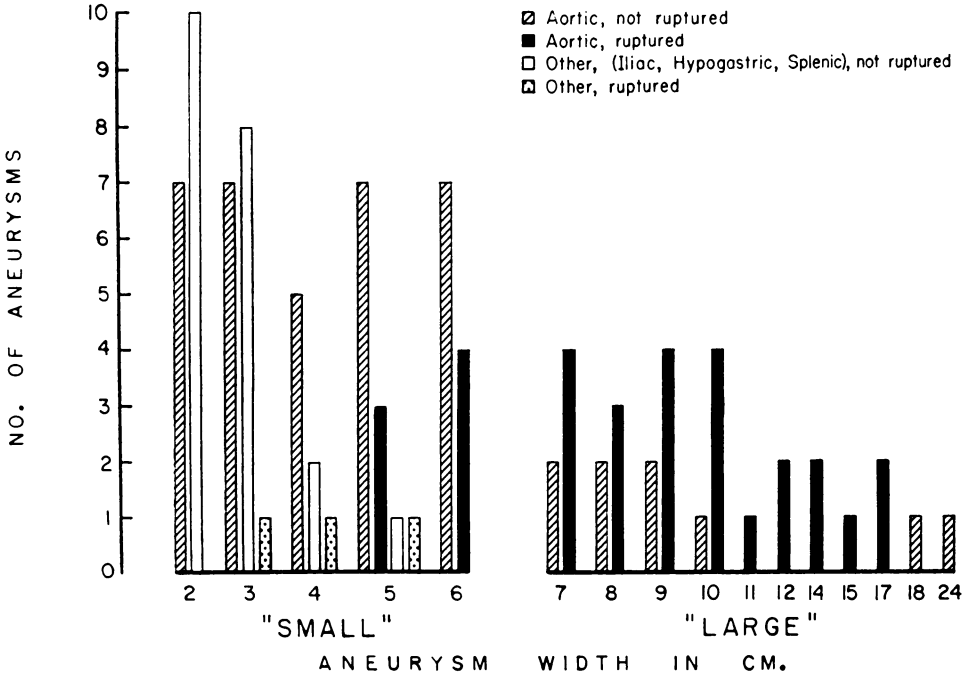


FIG. 2.

myocardial damage. In addition, a number of patients entered the hospital actively bleeding and information and signs were not adequate to evaluate the prior presence of hypertension. There was no significant difference between the incidence of hypertension in the ruptured and unruptured group.

In the group of 72 abdominal aortic aneurysms, only six arteriosclerotic aneurysms were located in the abdominal aorta above the renal arteries; 8 luetic aneurysms, however, were located below the renal arteries. The remainder of the artriosclerotic cases were below the renal arteries and the luetic cases above the renal arteries. This is with the exception of three luetic iliac aneurysms (in two patients) and one patient with bilateral luetic hypogastric aneurysms.

Overall, 60 per cent of the aneurysms were saccular (61% of the ruptured and 59% of the unruptured). The luetic aneurysms were saccular to fusiform in the ratio of 5 : 1. The arteriosclerotics were almost equally divided between fusiform and saccular.

Antemortem clot in the aneurysm, either interstitial or laminated blood, was almost always present in this group. Four small aneurysms were described as not having other than a severely ulcerated, atheromatous intima. Several aneurysms had tubular lumina that were equivalent to the aortic lumen and would not have been visualized as a filling defect by aortography.

In all but three of the ruptured cases the retroperitoneal space was filled with blood. In one case an arteriosclerotic aneurysm of the superior mesenteric artery ruptured into the transverse duodenum. In the two other cases, luetic aneurysms of the upper abdominal aorta ruptured through the diaphragm into the right and left pleural spaces. The retroperitoneal hematoma was usually largely confined to the left as in Crane's [4] group. In all the ruptured aneurysms the site of perforation was the body of the aneurysm; in no case did perforation

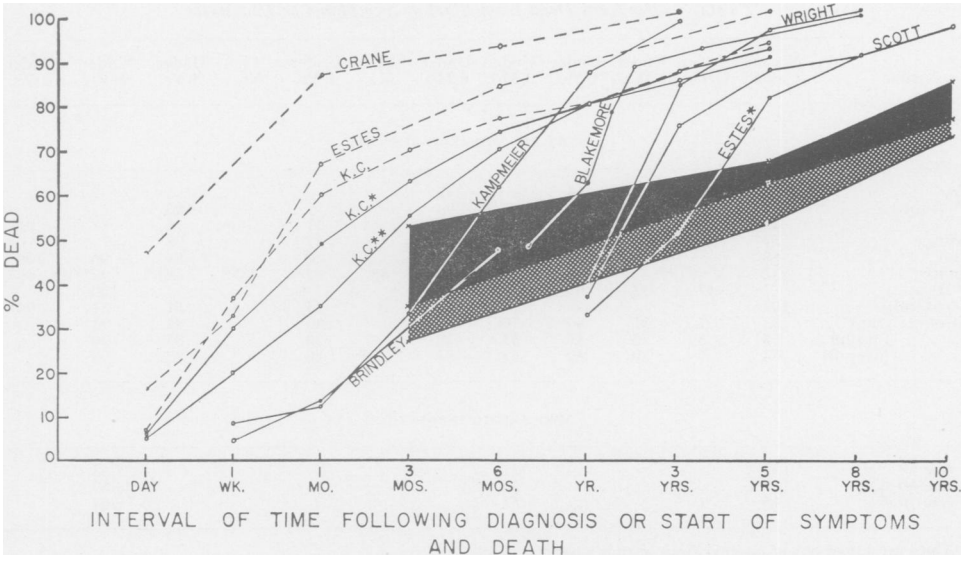


FIG. 3. Survival time. Stippled area = age 50–69, demarcation line between 2 darkened areas = age 60–69, black shaded area = age 60–89; representing expected death from myocardial infarction (Cole). Dotted lines = aneurysms that ruptured. *= ruptured and unruptured data combined ('Overall' in Table II). **= unruptured anerysms.

occur at the junction of a relatively normal vessel with the aneurysm. The estimated quantity of blood in the recipient space of rupture was usually over 1000 ml. though it ranged from 750 ml. to 3 liters.

The 96 anuerysms were tabulated according to greatest width after Crane [4] (Fig. 2). The sizes ranged from 2 cm. to 24 cm. The majority of the 2 and 3 cm. aneurysms were in the iliac, splenic, and hypogastric vessels.

The 72 aortic aneurysms were classified large and small on the basis of a width of 7 cm. or over, and less than 7 cm. There were 40 small aortic aneurysms and 32 large aortic aneurysms. Seven, or 17.5 per cent, of the small aneurysms were ruptured while 23, or 72 per cent, of the large aneurysms were ruptured. Crane [4] made a similar division and found that 82 per cent of the large aneurysms (7 cm. or over) and 4 per cent of the small aneurysms (6 cm. or less) were ruptured.

The ability to predict the eventual outcome of an untreated case certainly is a factor in treatment. For this reason the interval of time from the start of symptoms or diagnosis to death were tabulated. An attempt was made to obtain similar figures from other authors.[1, 2, 4-7, 9] Unfortunately, all the reported studies did not give equivalent data and in some cases only a small segment of a series was reported in sufficient detail to be included. Surgically treated cases were excluded except for an occasional patient which could not be isolated from a larger reported group. Generally, the figures relate only to aortic aneurysms. In our group of cases all intra-abdominal aneurysms were included. Four studies, of Blakemore,[1] Estes,[5] Scott,[7] and Wright,[9] were based on patients clinically, often incidentally, diagnosed as having aneurysms, while the studies of Brindley,[2] Kampmeier,[6] Crane,[4] and of the Kings County Hospital group were primarily retrospective necropsy studies and relied heavily on pre-existing symptoms attributable to an aneurysm. The findings of the various groups showed a considerable variation. The figures ranged

TABLE 2. *Per Cent Dead from Start of Symptoms or Diagnosis*

Author	No. of Cases	Under 1 Day	Under 1 Wk.	Under 1 Mo.	Under 3 Mo.	Under 6 Mo.	8 Mo.	Under 1 Yr.	1½ Yr.	Under 3 Yr.	Under 5 Yr.	Under 8 Yr.	Under 10 Yr.
INTRA-ABDOMINAL ANEURYSMS													
Brindley	40		5	14		47							
Crane* (rupt.)	15	47		87		93				100			
Scott	48							37		75	87	90	96
Kampmeier	57		9	12	33	61		87		98			
Wright	68							40		84	96	100	
Blakemore	131						48	62	78**	88*.†	92**.††	99**	
Estes* (rupt.)	7	17	33	67		84					100		
(overall)	102							33		51	81	90	
Kings County (rupt.)	33	7	37	60	70	77		80		87	93		
(unrupt.)	35	5	20	35	55	70		80		85	90		
(overall)	68	6	30	49	63	74		80		87	92		
MYOCARDIAL INFARCTION													
Cole Age 50–59:	152				27						53		72
Age 60–69:	117				35						62		76
Age 70–89:	45				53						67		84

* Data are taken out of context from author's paper.
** Data are read from Blakemore's graph.
† Dead at 2 years.
†† Dead at 3½ years.

from 47 per cent dead in one day after symptoms to 33 per cent dead at one year. The significant factors in interpreting the data appeared to be: 1) whether the patient was symptomatic or whether the diagnosis of abdominal aneurysm was made incidentally on physical examination, and 2) whether the patient entered the hospital at the time of a vascular rupture. The survival time in necropsy studies (dependent upon a retrospective study of symptoms) was considerably less than when the aneurysm was diagnosed incidentally in an asymptomatic patient. In all studies, though the numbers are small, the patients who entered with a rupturing aneurysm appeared to have a short symptomatic prodromal period and a quite short survival time following the start of symptoms.

Figure 3 plots the survival data gleaned from reported series of essentially untreated cases. Also charted for comparison are survival figures for a group of patients in the same age group following myocardial infarction.

DISCUSSION

The causes of death point out the problem of local treatment of a generalized disease. While 48 per cent might have been saved from vascular rupture by a grafting procedure, the question as to whether ultimate survival would have been longer remains to be resolved by large groups subjected to grafting procedures. An incidence of 35 per cent of myocardial infarction in this age group is not conducive to long survival. The figures of Cole *et al.* on survival following myocardial infarction are included in Table 2 and plotted in Figure 3. Sixty per cent of his patients were dead five years after myocardial infarction.

With nine of 14 patients with luetic aneurysms having a second aortic aneurysm, and eight of the nine patients with multiple luetic aneurysms having a thoracic aneurysm, even local therapy becomes a problem. It would seem that a luetic abdominal aneurysm represents an end stage of luetic vasculitis with a toll having already been exacted from the thoracic aorta.

The possibility of a second aneurysm must, therefore, be kept in mind. We have had the experience of resecting an abdominal aneurysm, having the patient die 40 days postresection from a "spontaneous" rupture at the homograft-host vessel junction, and finding a second thoraco-abdominal aneurysm at the level of the diaphragm at necropsy. This patient had had severe abdominal and back pain for six years. His symptoms had persisted following resection.

The location of the abdominal aortic aneurysm is mainly dependent upon the etiologic factors, with luetic above and arteriosclerotic below the renal arteries. However, luetic aneurysms were found below as well as arteriosclerotic aneurysms above the renal arteries. This has some importance because. There is a considerable chance of a luetic abdominal aneurysm being multiple. Certainly a patient with a suspected abdominal luetic aneurysm should be carefully studied for the presence of another vascular aneurysm.

Whether patients spontaneously seal a rupture in an abdominal aneurysm is a moot point. However, it does not appear that an abdominal aneurysm will spontaneously seal after *frank* rupture with the retroperitoneal blood resorbing and the patient temporarily recovering.

Aneurysms with a width greater than 7 cm. present the greatest overall risk of rupture. If these or Crane's figures are representative, a patient with an aneurysm of over 7 cm. has at least a 70 per cent chance of rupturing in the future.

The individual survival based on the duration of symptoms or the time following diagnosis still is unanswered. However, these patients pass through three phases: 1) a period of asymptomatic disease, 2) a symptomatic prelude, and 3) the rupturing phase. The survival of groups of patients appears to be dependent upon which phase the patients are in at the time of diagnosis. Probably, if the aneurysm is a chance examination finding, with no attendant symptoms, the figures of Estes, Scott, and Wright are more valid. On the other hand, aneurysms that have become symptomatic place the patient in a poorer prognostic group and survival falls in the range of the figures of Brindley, Kampmeier, and this study. Therefore, patients with symptomatic aneurysms should be treated immediately. Those patients that are asymptomatic will then become a problem of selection. Perhaps the smaller aneurysms in the poorer risk patients should be unmolested. How long it takes for a "small" aneurysm to get "large" is not known. We have watched one 4 cm. aneurysm for two and a half years with no apparent change in size.

In reporting survival following resections for aneurysms, it would seem important to state whether the patient was asymptomatic, symptomatic but not rupturing, or rupturing, since the natural survival based on these different groups appears different.

SUMMARY

1. Ninety-six aneurysms of the aorta, iliac and other abdominal branches were studied from necropsy reports to determine the natural history of the disease and to attempt some clinico-pathologic correlations.

2. The survival time appeared to coincide with other necropsy studies. Thirty per cent of the patients were dead within one month of symptoms, 74 per cent were dead under six months and 80 per cent were dead in less than one year. The survival rate of this group is much lower than in a group of patients in which an aneurysm was incidentally noted on diagnosis.

3. Patients with luetic abdominal aneurysms frequently had another aortic aneurysm (nine out of 14 patients, or 64 per cent).

4. Forty-nine per cent of the patients with adbdominal aneurysms died from a vascular rupture. Only 4 per cent of patients wtih aneurysms died from a disease that was apparently entirely unrelated to their aneurysm or its underlying cause.

5. Seventy-two per cent of all aneurysms 7 cm. wide or over were ruptured. Less than 18 per cent of the aneurysms under 7 cm. were ruptured.

6. Hypertension was clearly present in 47 per cent of the patients with arteriosclerotic aneurysms and 35 per cent showed definite evidence of previous myocardial infarction.

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